

ULTRASOUND SCANS NOT SO SAFE AND SOUND

Ultrasound has been promoted as risk-free and satisfying for prospective parents, but scientific research reveals serious concerns about its safety and usefulness.

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When I was pregnant with my first baby in 1990, I decided against having an ultrasound scan. This was a rather unusual decision, as my partner and I are both doctors and had even done pregnancy scans ourselves—rather ineptly, but sometimes usefully—while training in GP obstetrics a few years earlier.

What influenced me the most was my feeling that I would lose something important as a mother if I allowed someone to test my baby. I knew that if a minor or uncertain problem showed up (this is not uncommon), I would be obliged to return again and again, and that after a while it would feel as if my baby belonged to the system and not to me.

In the years since then, I have had three more unscanned babies and have read many articles and research papers about ultrasound. Nothing I have read has made me reconsider my decision.

Although ultrasound may sometimes be useful when specific problems are suspected, my conclusion is that it is at best ineffective and at worst dangerous when used as a "screening tool" for every pregnant woman and her baby.

ULTRASOUND, PAST AND PRESENT

Ultrasound was developed during World War II to detect enemy submarines, and was subsequently used in the steel industry.

In July 1955, Glasgow surgeon Ian Donald borrowed an industrial machine and, using beefsteaks as controls, began to experiment with abdominal tumours which he had removed from his patients.

He discovered that different tissues gave different patterns of "echo", leading him to realise that ultrasound offered a revolutionary way to look into the previously mysterious world of the growing baby (Wagner, 1995).

This new technology spread rapidly into clinical obstetrics. Commercial machines became available in 1963 (de Crespigny, 1996), and by the late 1970s ultrasound had become a routine part of obstetric care (Oakley, 1986).

Today, ultrasound is seen as safe and effective, and scanning has become a rite of passage for pregnant women in developed countries. Here in Australia, it is estimated that 99% of babies are scanned at least once in pregnancy—mostly as a routine prenatal ultrasound (RPU) at four to five months.

However, there is growing concern as to ultrasound's safety and usefulness. UK consumer activist Beverley Beech has called RPU "the biggest uncontrolled experiment in history" (Beech, 1993), and the Cochrane Collaborative Database—the peak scientific authority in medicine—concludes that "no clear benefit in terms of a substantive outcome measure like perinatal mortality [number of babies dying around the time of birth] can yet be discerned to result from the routine use of ultrasound" (Neilson, 2002).

This seems a very poor reward for the huge costs involved. In 1997–98, for example, A\$39 million was paid by the Australian federal government for pregnancy scans—an enormous expense compared to \$54 million for all other obstetric Medicare costs. This figure does not include the additional costs paid by the woman herself.

The 1999 Australian Senate Committee report, "Rocking the Cradle", recommended that the costs and benefits of routine scanning and current ultrasound practices be formally assessed. Recommendations were also made to develop guidelines for the safe use of all obstetric ultrasound, as well as for the development of standards for the training of ultrasonographers (Senate Community Affairs Reference Committee, 1999). So far, none of these recommendations has been implemented.

ULTRASOUND TECHNOLOGY AND TECHNIQUES

The term "ultrasound" refers to the ultra high frequency sound-waves used for diagnostic scanning. These waves travel at 10–20 million cycles per second, compared to 10,000–20,000 cycles per second for audible sound (de Crespigny, 1996). Ultrasound waves are emitted by a transducer (the part of the machine that is put onto the body), and a picture of the underlying tissues is built up from the pattern of "echo" waves that return. Hard surfaces such as bone return a stronger echo than soft tissue or fluids, giving the bony skeleton a white appearance on the screen.

Ordinary scans use pulses of ultrasound which last only a fraction of a second, with the interval between waves being used by the machine to interpret the echo that returns. In contrast, Doppler techniques, which are used in specialised scans, foetal monitors and hand-held foetal stethoscopes ("sonicaids"), feature continuous waves, giving much higher levels of exposure than "pulsed" ultrasound. Many women do not realise that the small machines used to listen to their baby's heartbeat are actually using Doppler ultrasound, albeit with low dose parameters.

More recently, ultrasonographers have been using vaginal ultrasound, where the transducer is placed high in the vagina, much closer to the developing baby. This is used mostly in early pregnancy, when abdominal scans can give poor pictures. However, with vaginal ultrasound, there is little intervening tissue to shield the baby, who is at a vulnerable stage of development, and exposure levels will be high. Having a vaginal ultrasound is not a pleasant procedure for the woman; the term "diagnostic rape" was coined to describe how some women experience vaginal scans.

Another recent application for ultrasound is the nuchal translucency test, where the thickness of the skin fold at the back of the baby's head is measured at around three months. A thick nuchal (neck) fold makes the baby more likely, statistically, to have Down's syndrome. When the baby's risk is estimated to be over 1 in 250, a definitive test is recommended. This involves taking some of the baby's tissue by amniocentesis or chorionic villus sampling.

Around 19 out of 20 babies diagnosed as "high risk" by nuchal translucency will not turn out to be affected by Down's syndrome, and their mothers will have experienced several weeks of unnecessary anxiety. A nuchal translucency scan does not detect all babies affected by Down's syndrome.

INFORMATION GAINED FROM ULTRASOUND

Ultrasound is mainly used for two purposes in pregnancy: either to investigate a possible problem at any stage of pregnancy, or as a routine scan at around 18 weeks.

If there is bleeding in early pregnancy, for example, ultrasound may predict whether miscarriage is inevitable. Later in pregnancy, ultrasound can be used when a baby is not growing or when a breech baby or twins are suspected. In these cases, the information gained from ultrasound can be very useful in decision-making for the woman and her carers. However, the use of routine prenatal ultrasound is more controversial, as this involves scanning (or "screening") all pregnant women in the hope of improving the outcome for some mothers and babies.

The timing of routine scans (at 18 to 20 weeks) is chosen for

pragmatic reasons. It offers a reasonably accurate due date—although dating is most accurate at the early stages of pregnancy when babies vary the least in size—and the baby is big enough for most abnormalities to be seen that are detectable with ultrasound. However, at this stage, the EDD (expected date of delivery) is only accurate to a week either side, and some studies have suggested that an early examination or calculations based on a woman's menstrual cycle can be as accurate as RPU (Olsen, 1997; Kieler, 1993).

And while many women are reassured by a normal scan, RPU actually detects only between 17% and 85% of the 1 in 50 babies who have major abnormalities at birth (Ewigman, 1993; Luck, 1992). A recent study from Brisbane showed that ultrasound at a major women's hospital missed around 40% of abnormalities, with most of these being difficult or impossible to detect (Chan, 1997). Major causes of intellectual disability such as cerebral palsy and Down's syndrome are unlikely to be picked up on a routine scan, as are heart and kidney abnormalities.

When an abnormality is detected, there is a small chance that the finding is a "false positive", where the ultrasound diagnosis is wrong. A UK survey showed that, for 1 in 200 babies aborted for major abnormalities, the diagnosis on post-mortem was less severe than predicted by ultrasound and the termination was probably unjustified. In this survey, 2.4% of the babies diagnosed

with major malformations, but not aborted, had conditions that were significantly over- or under-diagnosed (Brand, 1994).

There are also many cases of error with more minor abnormalities, which can cause anxiety and lead to repeated scans, and there are some conditions which have been seen to resolve spontaneously (see, for example, Saari-Kemppainen, 1990).

As well as false positives, there are also uncertain cases where the ultrasound findings cannot be easily interpreted and the outcome for the baby is

not known. In one study involving women at high risk, almost 10% of scans were uncertain (Sparling, 1988). This can create immense anxiety for the woman and her family, and the worry may not be allayed by the birth of a normal baby. In the same study, mothers with "questionable" diagnoses still had this anxiety three months after the birth of their baby.

In some cases of uncertainty, the doubt can be resolved by further tests such as amniocentesis. In this situation, there may be up to two weeks' wait for results, during which time a mother has to decide if she will terminate the pregnancy if an abnormality is found. Even mothers who receive reassuring news have felt that this process has interfered with their relationship with their baby (Brookes, 1994-95).

As well as estimating the EDD and checking for major abnormalities, RPU can also identify a low-lying placenta (placenta praevia) and detect the presence of more than one baby at an early stage of pregnancy. However, 19 out of 20 women who have placenta praevia detected on an early scan will be needlessly worried: the placenta will effectively move up and not cause problems at the birth. Furthermore, detection of placenta praevia by RPU has not been found to be safer than detection in labour (Saari-Kemppainen, 1990).

No improvement in outcome has been shown for multiple pregnancies, either; the vast majority of these will be detected before

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labour, even without routine prenatal ultrasound (MIDIRS, 1995).

The American College of Obstetricians, in their guidelines on routine ultrasound in low-risk pregnancy, conclude that: "In a population of women with low-risk pregnancies, neither a reduction in perinatal morbidity [harm to babies around the time of birth] and mortality nor a lower rate of unnecessary interventions can be expected from routine diagnostic ultrasound. Thus ultrasound should be performed for specific indications in low-risk pregnancy" (ACOG, 1997).

BIOLOGICAL EFFECTS OF ULTRASOUND

Ultrasound waves are known to affect tissues in two main ways. Firstly, the sonar beam causes heating of the highlighted area by about 1° Celsius. This is presumed to be non-significant, based on whole-body heating in pregnancy, which seems to be safe up to 2.5°C (American Institute of Ultrasound Medicine Bioeffects Report, 1988).

The second recognised effect is cavitation, where the small pockets of gas which exist within mammalian tissue vibrate and then collapse. In this situation: "...temperatures of many thousands of degrees Celsius in the gas create a wide range of chemical products, some of which are potentially toxic. These violent processes may be produced by micro-second pulses of the kind which are used in medical diagnosis..." (*American Inst. of Ultrasound Medicine Bioeffects Report*, 1988). The significance of cavitation effects in human tissue is unknown.

A number of studies have suggested that these effects are of real concern in living tissues. The first study suggesting problems was a study on cells grown in the lab. Cell abnormalities caused by exposure to ultrasound were seen to persist for several generations (Liebeskind, 1979). Another study showed that, in newborn rats (who are at a similar stage of brain development to humans at four to five months *in utero*), ultrasound can damage the myelin that covers nerves (Ellisman et al., 1987), indicating that the nervous system may be particularly susceptible to damage from this technology.

A 1999 animal study by Brennan and colleagues, reported in *New Scientist* (12 June 1999), showed that exposing mice to dosages typical of obstetric ultrasound caused a 22% reduction in the rate of cell division and a doubling of the rate of apoptosis, or programmed cell death, in the cells of the small intestine.

Mole (1986) comments: "If exposure to ultrasound...causes death of cells, then the practice of ultrasonic imaging at 16 to 18 weeks will cause loss of neurones [brain cells] with little prospect of replacement of lost cells... The vulnerability is not for malformation but for maldevelopment, leading to mental impairment caused by overall reduction in the number of functioning neurones in the future cerebral hemispheres."

Studies on humans exposed to ultrasound have shown that possible adverse effects include premature ovulation (Testart, 1982), preterm labour or miscarriage (Lorenz, 1990; Saari-Kemppainen, 1990), low birth weight (Newnham, 1993; Geerts, 1996), poorer condition at birth (Thacker, 1985; Newnham, 1991), perinatal death (Davies, 1992), dyslexia (Stark, 1984), delayed speech development (Campbell, 1993), and less right-handedness (Salvesen, 1993; Kieler, 1998a; Salvesen, 1999). Non-right-handedness is, in other circumstances, seen as a marker of damage to the developing brain (Odent, 1998). One Australian

study showed that babies exposed to five or more Doppler ultrasounds were 30% more likely to develop intra-uterine growth retardation (IUGR)—a condition that ultrasound is often used to detect (Newnham, 1993).

Two long-term randomised controlled trials, comparing exposed and unexposed children's development at eight to nine years old, found no measurable effect from ultrasound (Salvesen, 1992; Kieler, 1998b). However, as the authors note, intensities used today are many times higher than in 1979 to 1981. Further, in the major branch of one trial, scanning time was only three minutes (Salvesen, 1993). More studies are obviously needed in this field, particularly in the areas of Doppler and vaginal ultrasound where exposure levels are much higher.

A further problem with studying ultrasound's effects is the huge range of output, or dose, possible from a single machine. Modern machines can give comparable ultrasound pictures using a lower or a 5,000 times higher dose (Meire, 1987), and there are no standards to ensure that the lowest dose is used. Because of the complexity of machines, it is difficult even to quantify the dose given in each examination (Taylor, 1990). In Australia, training is voluntary, even for obstetricians, and the skill and experience of operators varies widely.

A summary of the safety of ultrasound in human studies, published in May 2002 in the prestigious US journal *Epidemiology*, concluded: "...there may be a relation between prenatal ultrasound exposure and adverse outcome. Some of the reported effects include growth restriction, delayed

speech, dyslexia, and non-right-handedness associated with ultrasound exposure. Continued research is needed to evaluate the potential adverse effects of ultrasound exposure during pregnancy. These studies should measure the acoustic output, exposure time, number of exposures per subject, and the timing during the pregnancy when exposure(s) occurred" (Marinac-Dabic, 2002).

The UK consumer organisation AIMS (Association for Improvements in the Maternity Services) has produced a booklet, "Ultrasound Unsound?", originally published in 1993 and recently updated. This very comprehensive publication, which I highly recommend, includes a form that pregnant women undergoing ultrasound can ask their carers to fill out. You can make your own form based on the information as below, or obtain the booklet at website <http://www.birthinternational.com.au>.

WOMEN'S EXPERIENCES WITH ULTRASOUND

Women have not been consulted at any stage in the development of this technology, and their experiences and wishes are presumed to coincide with, or be less important than, the medical information that ultrasound provides. For example, supporters of RPU presume that early diagnosis and/or termination is beneficial to the affected woman and her family.

However, the discovery of a major abnormality on RPU can lead to very difficult decision-making. Some women who agree to have an ultrasound are unaware that they may get information about their baby that they do not want, as they would not contemplate a termination. Other women can feel pressured to have a termination, or at the least feel some emotional distancing from their "abnormal" baby (Brookes, 1994–95).

Furthermore, there is no evidence that women who have chosen termination are, in the long term, psychologically better off than

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My Baby's Ultrasound Exposure Record

The following procedure requires the use of ultrasound

This is necessary to obtain the following information

To my knowledge, there is no current alternative method available to obtain this information that carries less risk to

(mother's name)

Signature (doctor or midwife)..... Date

The ultrasonographer is asked to specify:

Manufacturer and model of ultrasound equipment

Date of last calibration

Type or combination of types of ultrasound used

Intensity of exposure (w/cm sq or mW/cm sq)

Time commenced Time completed

Duration of exposure

Name of hospital or clinic

Carried out by

Qualifications Position.....

Signature Date.....

CONCLUSIONS AND RECOMMENDATIONS

I would urge all pregnant women to think deeply before they choose to have a routine ultrasound. It is not compulsory, despite what some doctors have said, and the risks, benefits and implications of scanning need to be considered for each mother and baby according to their specific situation.

If you choose to have a scan, be clear about the information that you do and do not want to be told. Have your scan done by an operator with a high level of skill and experience (usually this means someone who performs at least 750 scans per year) and say that you want the shortest scan possible. Ask them to fill out the form or give you the information, as above, and to sign it.

If an abnormality is found, ask for counselling and a second opinion as soon as practical. And remember that it's *your* baby, *your* body and *your* choice.

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women whose babies have died at birth; in fact, there are suggestions that the opposite may be true in some cases (Watkins, 1989).

And when termination has been chosen, women are unlikely to share their story with others and can experience considerable guilt and pain from the knowledge that they themselves chose the loss (MIDIRS, 1996).

When minor abnormalities are found—which may or may not be present at birth, as discussed above—women can feel that some of the pleasure has been taken away from their pregnancy.

Women's experiences with ultrasound and other tests used for prenatal diagnosis (e.g., amniocentesis) are thoughtfully presented by Barbara Katz Rothman in her book, *The Tentative Pregnancy*. The author documents the heartache that women can go through when a difficult diagnosis is made; this pain can take years for some women to resolve. She suggests that the large numbers of screening tests currently being offered to check for abnormalities may make every woman feel that her pregnancy is "tentative" until she receives reassuring results.

To my mind, ultrasound also represents yet another way in which the deep internal knowledge that a mother has of her body and her baby is made secondary to technological information that comes from an "expert" using a machine. Thus the "cult of the expert" is imprinted from the earliest weeks of life.

Furthermore, by treating the baby as a separate being, ultrasound artificially splits mother from baby well before this is a physiological or psychic reality. This further emphasises our culture's favouring of individualism over mutuality and sets the scene for possible—but, to my mind, artificial—conflicts of interest between mother and baby in pregnancy, birth and parenting.

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